

Deliverable For:

**Gateway Cities Traffic Signal Synchronization
and Bus Speed Improvement Project**

Atlantic Boulevard/I-710 Corridor

Deliverable 2.2.1

Version 0

**Initial Concept of Operations Report
Draft**

Submitted To:

**Los Angeles County
Department of Public Works**

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1 INTRODUCTION

The County of Los Angeles Department of Public Works Traffic Signal Synchronization, Operation and Maintenance (SOM) program has proven successful in creating an institutional infrastructure to coordinate the activities of the agencies responsible for traffic signal operations in the County. A key feature of this infrastructure is the Forums - groups of bordering agencies created to encourage and promote inter-agency cooperation. These Forums have enabled funding to be targeted at infrastructure improvements along arterial and arterial/freeway corridors in the County's sub-regions. Such projects are a critical part of what will eventually be a network of integrated ITS systems in Los Angeles County and in Southern California.

The Atlantic Blvd./I-710 Corridor is one such project which will result in arterial infrastructure improvements on north-south and east-west arterials along I-710 freeway in the South-East LA County (Gateway Cities) Forum.

As shown in Figure 1-1, the Atlantic Blvd./I-710 project area consists of 678 intersections in the following 15 different jurisdictions, comprising 13 cities, the County and Caltrans.

- Los Angeles County
- Caltrans
- City of Bell
- City of Bell Gardens
- City of Commerce
- City of Compton
- City of Cudahy
- City of Huntington Park
- City of Long Beach
- City of Lynwood
- City of Maywood
- City of Paramount
- City of Signal Hill
- City of South Gate
- City of Vernon

The objective of this project is to design, develop and deploy Advanced Traffic Control system(s) (ATMS) in the corridor so that the signals in the Project area can be synchronized across the jurisdictional boundaries. This project concentrates on the needs of the agencies in this corridor with respect to signal synchronization and recommends improvements to field infrastructure (including controllers, loops, detectors, and communications) and central traffic control systems to meet those needs.

When successfully completed, each of the agencies responsible for traffic signal operations in the Atlantic Blvd./I-710 Corridor will have full access to a ATMS that monitors and controls the traffic signals under their jurisdiction. Agencies will be able to synchronize their signals with neighboring agencies, and exchange traffic information in real-time. Agencies will also be able to exchange data with other agencies in the Gateway Cities region. This will allow the agencies to respond to recurrent and non-recurrent congestion in a coordinated fashion across the jurisdictional boundaries.

1.1 Relationship with the Countywide Arterial Management System

The County DPW has developed a system architecture for integrating Advanced Traffic Management Systems (ATMS) for arterial traffic control systems into a regional framework to support the above operational goals. This is the Information Exchange Network architecture (IEN) represented in Figure 1-2. This is the architecture that will be followed in the design of the Atlantic Blvd./I-710 Project.

Figure 1-1: Atlantic Blvd. /I-710 Corridor Project Area

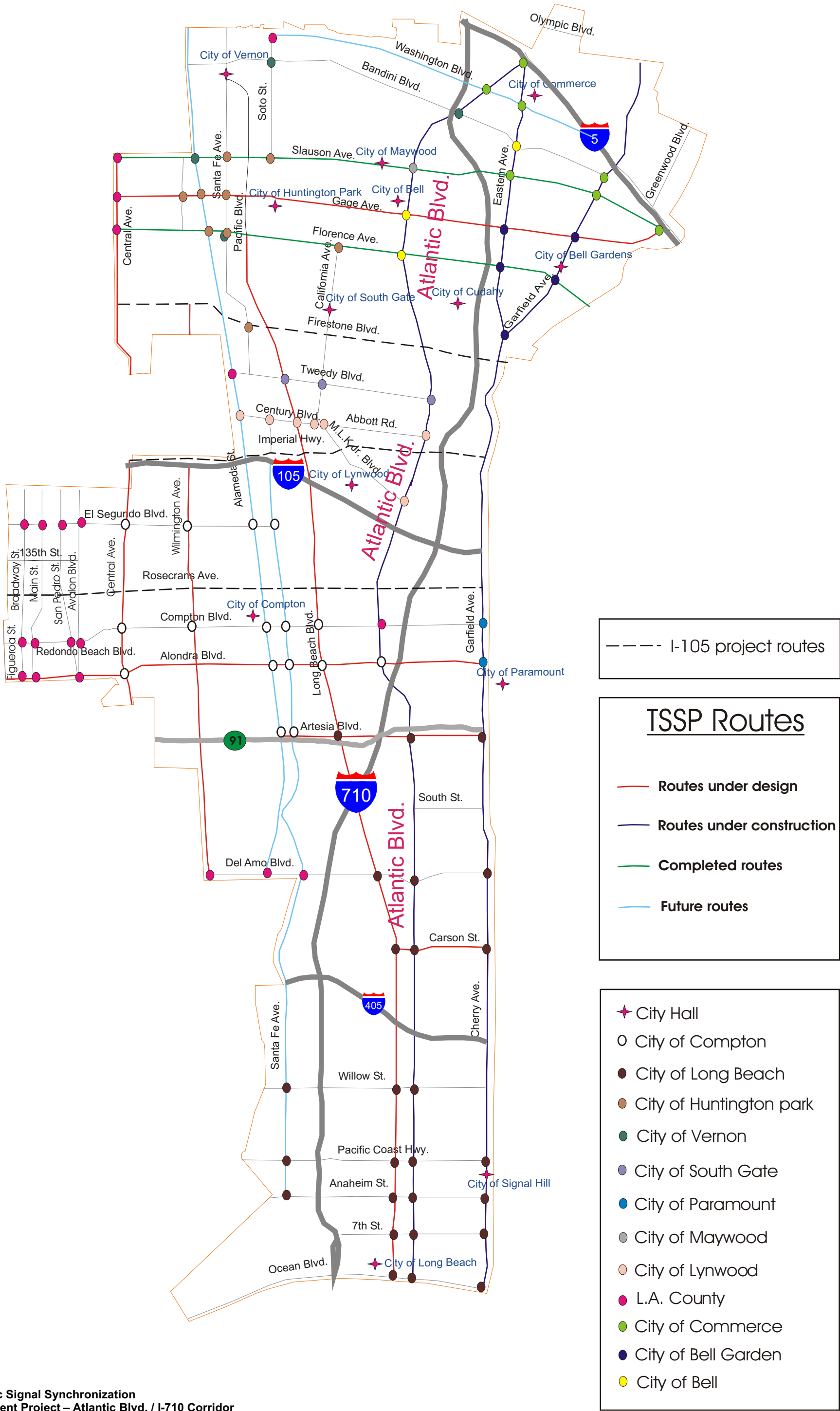
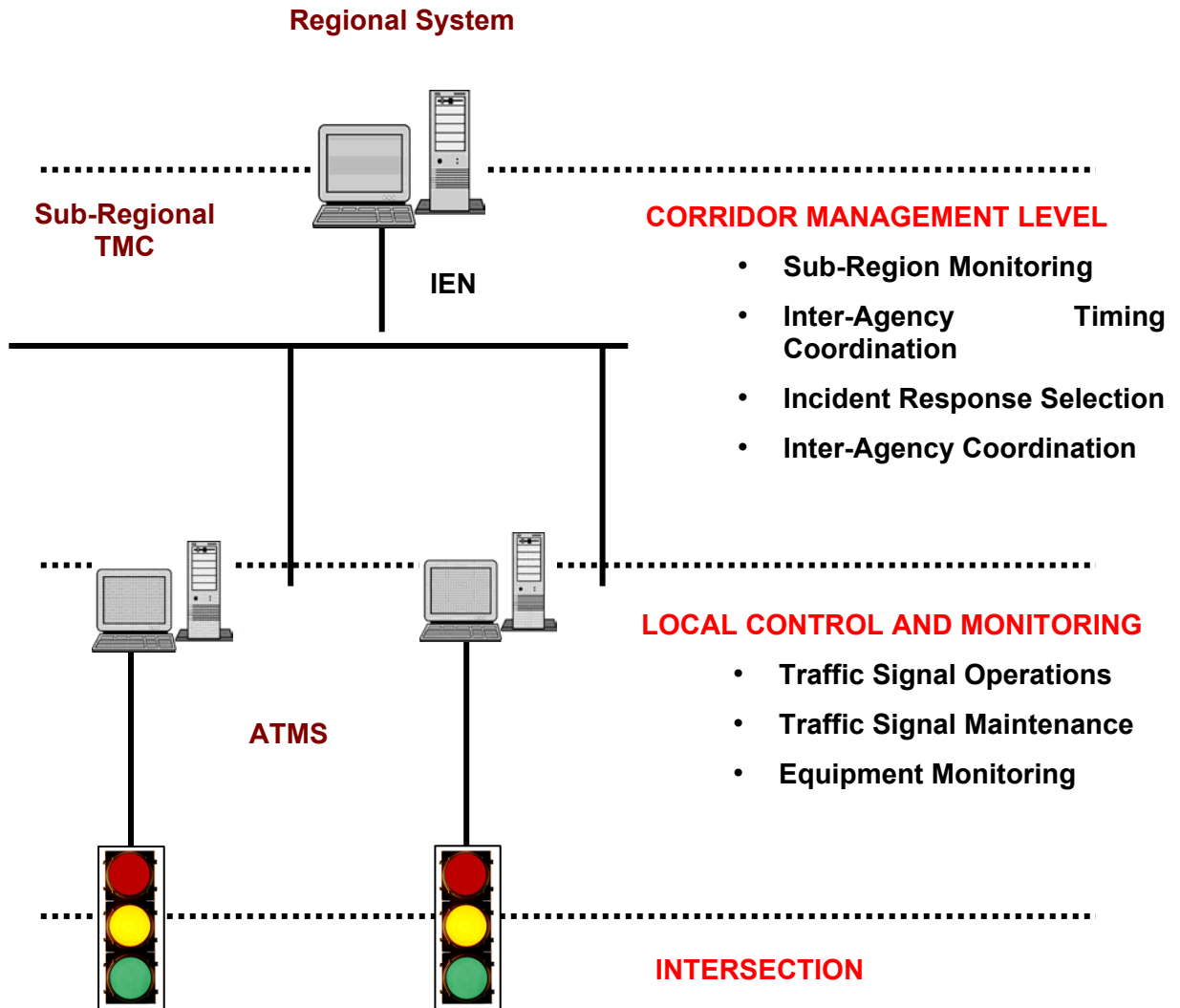


Figure 1-2: The Information Exchange Network Architecture (IEN)



The IEN architecture supports traffic signal operations in three levels. The local level comprises the day-to-day, traffic signal operations carried out by the individual agency – signal timing, maintenance and response to local traffic conditions and events. The Corridor level supports inter-agency coordination and joint signal operations – coordination across jurisdictional boundaries, exchange of local traffic data, and joint response to traffic conditions and events that affect more than one jurisdiction. The final level is the regional level. This permits the arterials of regional significance to be monitored and managed as a single entity (as Caltrans does with the freeway system). Multi-agency, cross-corridor data exchange is supported permitting a countywide response to traffic conditions and major events. The physical elements of the architecture are ATMSs, interfaces between the ATMS and the regional system, workstations to display shared data (which may or may not be combined with the ATMS), and servers for the collection/transfer of data and to support corridor and regional functions. These components are connected via a communications network known as the Information Exchange Network (IEN). The design of the IEN is being

developed as part of the East San Gabriel Valley (ESGV) Pilot Project. The initial application of this structure in the Gateway Cities region is being done under the auspices of the I-105 Corridor Project which has jurisdictions in common with the Atlantic Blvd./I-710 Project.

The Atlantic Blvd./I-710 Project assumes the availability of the IEN at the corridor and regional levels. The project is focused upon the selection of traffic control systems and integration of those systems into the IEN at the local level. The eventual design will include IEN workstations at the local level. These are being defined as part of other projects. The design of the traffic control systems will, however, take into account the interface to the IEN and its requirements at the local level.

1.2 Purpose

The Atlantic Boulevard/I-710 Corridor Concept of Operations will provide a high level system overview of this project. The Concept of Operations will serve as the foundation in which this project can be deployed using the systems engineering process. This document will provide stakeholders at any level or background with an overview of the project and what it will accomplish.

This document will however not provide detailed capabilities of this project. It will also not contain detailed system design and its functions. These elements are reserved for other reports that will address system requirements and design.

2 CONCEPT OF OPERATIONS

2.1 Project Components

The ATMS to be deployed under this project will allow local agencies to control traffic signal operations without being in the field and to monitor traffic signal operations for malfunctions. With the ability to monitor their traffic signals, agencies will be provided with an immediate notification of signal malfunctions, resulting in faster and more efficient maintenance responses. The traffic signal monitoring and control functions being implemented will also provide the basis for the inter-jurisdictional sharing of traffic signal status and congestion data that will permit local agencies to work together for the development of arterial traffic management strategies. These strategies will be applied to minimize traffic delays resulting from incidents, emergencies, malfunctions, and special events.

The ATMS to be deployed for the local agencies under this project can be broken down into the following functions.

- **Traffic Signal Control:** The ATMS will provide real-time local monitoring and control of an agency's traffic signals. Using one or more workstations, local agency traffic engineering staff will monitor traffic conditions as well as the status of the intersection traffic signal controllers.
- **Vehicle Detection:** An important element of the ATMS is vehicle detection that will provide traffic count and speed data to supplement the data that is available from existing traffic signal detectors. Vehicle detectors will provide traffic data at key intersections where the monitoring of traffic conditions is critical to the efficient movement of vehicles.
- **Closed Circuit Television (CCTV):** CCTV cameras will be deployed at selected intersections throughout the project area. The CCTV cameras will provide real-time video monitoring of traffic conditions, congestion, and incidents.

This project is being coordinated through the Gateway Cities Traffic Signal Forum. As the ATMS is developed, coordination with other Traffic Forum projects as well as other locally-initiated projects will be done so that the ATMS is deployed to maximize the benefits to the participating cities.

The following sections present a description of how the Atlantic Boulevard/I-710 Corridor ATMS will operate. It will address the following:

- What systems are involved?
- How the systems and agencies will work together?
- What will be accomplished?

2.2 USER-ORIENTED OPERATIONS

The project involves the County traffic operations and maintenance, local agency traffic operations and maintenance, transit operators/emergency management agencies, and travelers as users.

2.2.1 Los Angeles County Traffic Operations and Maintenance

Los Angeles County Department of Public Works traffic operations personnel based at the County's Traffic Management Center (TMC) will host the ATMS server(s) for its own traffic signals and for traffic signals operated by other local agencies that elect to use the County's ATMS; host the IEN server that will provide for the distribution of traffic and

incident data throughout the County, including to local agencies in the project area; monitor, operate, and maintain its own traffic signals and other field devices as well as the traffic signals and other field devices for other agencies that elect to contract with the County for these functions from ATMS workstations at the County's TMC; and, in the future, host a video data server to support the distribution and viewing of CCTV images by local agencies throughout the project area.

This project is planned to connect to the Gateway Cities Sub-regional TMC. The Sub-regional TMC will be located in the County TMC as recommended by the I-105 corridor project. Agreements as well as final placement and staffing levels will need to be signed and agreed upon.

2.2.2 Local Agency Traffic Operations and Maintenance

This project involves thirteen cities along the Atlantic Boulevard/ I-710 corridor. Each city will operate and maintain its own traffic signals and other ITS field devices according to one of the following three levels.

- Level 1: Agencies which only have ATMS client functions.
- Level 2: Agencies which host both ATMS client and server functions for their own jurisdiction only.
- Level 3: Agencies which host both ATMS client and server functions for their jurisdiction as well as for one or more cities.

Cities may determine at which level they wish to participate in this project, as participation at each level has varied hardware and staffing requirements. Furthermore, within each of the three levels, cities may elect to participate at a level of effort that meets each individual agency's objectives and requirements for traffic management.

Cities or agencies categorized at Level 1 will have ATMS client functions that include traffic signal monitoring and control capabilities. Level 1 cities will rely on the County or a neighboring jurisdiction for the ATMS server functions. Each Level 1 city will have one or more workstations connected to the ATMS server that will permit the local agency traffic operations staff to monitor and control their own traffic signals, vehicle detection systems, and other field devices such as CCTV cameras as these additional devices are deployed in the future.

Level 1 agencies will also be able to monitor the operation of other traffic signals in the project area as well as view incident data on a map-based user interface using an IEN workstation. Level 1 agencies will use the IEN workstation to view signal status, vehicle speeds, congestion levels, and incidents on a fully integrated map display. Additionally in the future, Level 1 agencies will be able to view CCTV camera feeds from cameras located throughout the project area using web-based or other video distribution and viewing software to be deployed as part of the ATMS.

Level 2 agencies will operate and maintain their traffic signals using their own ATMS. Each ATMS will be interfaced with the IEN server through a Command Data Interface (CDI) for data sharing with other agencies. Level 2 agencies will establish a Local Control Center (LCC) to house their ATMS server and workstation(s), and to provide a facility for their traffic engineering staff to monitor traffic signal operations and manage traffic operations in their jurisdiction. The LCC will house the necessary systems and equipment to allow local agency traffic engineering staff to monitor and control the operation of their own traffic controllers, vehicle detectors, CCTV cameras, and changeable message signs. From the LCC, local agency traffic engineering staff will be able to identify equipment malfunctions and congestion resulting from incidents and to

initiate appropriate maintenance or operational actions in response to the identified problems or incidents.

Level 3 agencies will operate and maintain their traffic signals using their own ATMS but will also host the ATMS server for other agencies. As for Level 2 agencies, each ATMS will be interfaced with the IEN server through a Command Data Interface (CDI) for data sharing with other agencies. Level 3 agencies will establish a Local Control Center (LCC) or Traffic Management Center (TMC) to house their ATMS server and workstation(s), and to provide a facility for their traffic engineering staff to monitor traffic signal operations and manage traffic operations in their jurisdiction. The LCC or TMC will house the necessary systems and equipment to allow local agency traffic engineering staff to monitor and control the operation of their own traffic controllers, vehicle detectors, CCTV cameras, and changeable message signs.

The County will likely host the ATMS server for a number of cities that currently have contracts or working relationships with the County for the operation and maintenance of their systems. However, other local agencies in the project area that have the resources and willingness to host neighboring agency traffic control systems may host the ATMS server for the neighboring agencies.

Each city within the project area will need to assess which level in which they will participate for this project. Initial interviews with cities have been performed. Appendix A provides minutes from these meetings. Further discussions will be required to finalize the levels each agency wishes to participate.

User oriented involvement required by local staff varies in relation to which level the city participates in the system. A Level 1 agency will have far less equipment and responsibility in maintaining a central system than a Level 2 and 3 agency. In general at any of the three levels, local agency staff will be responsible for system monitoring, timing plan updates, incident management, control and maintenance of their traffic infrastructure. The infrastructure will include signals, controllers, cameras and the communications system. These elements can be maintained by the agency or contracted to a private company for maintenance.

Local agency staff will be responsible for the occasional monitoring and decision making tasks required by the ATMS system. It will be the responsibility of local agency staff to determine at what level they wish to monitor the operation of their field devices. Certain cities may elect to monitor the system only during normal business hours while others may monitor their system twenty-four hours a day. For cities that plan to monitor their system for part of the day, agreements may be possible with other agencies to allow operators at those agencies to monitor traffic signals and other field devices when local city staff will not be monitoring and to operate these devices but interagency agreements of this type are not necessary under the proposed Concept of Operations.

With one or more ATMS workstations installed in a City LCC, traffic engineering staff will have the ability of changing their own timing plans without traveling to the field in order to make the changes. Timing plans may be manually or automatically changed based on time of day, traffic congestion, or local agency policy. The ATMS workstation(s) will also display equipment malfunctions to allow for quicker and more efficient response by maintenance staff or contractors.

Traffic engineering staff, when notified of incidents, will input incident information into the IEN workstation. They will also be responsible for the initial verification and clearing of incidents through the use of the ATMS system. Staff will also be responsible for

approving temporary predetermined and approved timing plans in response to incidents as necessary.

2.2.3 Transit Operators/Emergency Management Agencies

Transit Operators and Emergency Management Agencies may participate in the project through the use of one or more IEN workstation(s). Traffic and congestion data will be beneficial to these agencies to enhance their operating efficiency and ability to respond to incidents. IEN workstation(s) deployed for these agencies will allow dispatching personnel at these agencies to monitor incidents, traffic conditions, and congestion data.

Participating transit operators and emergency management agencies may enter data regarding incidents into the IEN network. The entering of incidents into the IEN network by transit operators and emergency management agencies would significantly enhance the effectiveness of the IEN as, in many instances, they are notified of incidents before traffic engineering personnel. Information from these agencies will allow for faster incident notification, verification, and clearing.

2.2.4 Travelers

Motorists will be able to navigate around incidents and move more quickly along arterial streets where traffic signal timings have been adjusted in response to incidents. Additionally, motorists will move more quickly along arterial streets where traffic signal timings have been synchronized across jurisdictional boundaries.

Motorists will also be able to view traffic and congestion data as well as projected travel times on the internet to determine which routes to take when planning trips in the Atlantic Boulevard/I-710 corridor. Traveler information will be made possible through the integration of the County's IEN and regional data sharing systems being deployed under the Regional Integration of Intelligent Transportation Systems (RIITS) as well as, in the future, integration with regional 511 systems. This will allow travelers to access 511 systems or websites to learn about incidents, lane or street closures, traffic congestion, and other travel-related information.

3 OPERATIONAL NEEDS AND ENVIRONMENT

The Advanced Traveler Management System (ATMS) system will provide the capabilities for each of the local agencies in the project area to monitor and operate traffic signal controllers and vehicle detection equipment, and, in the future, CCTV cameras and possibly Changeable Message Signs. Additionally, traffic signal status and traffic data for neighboring cities will be available for each local agency through the County's Information Exchange Network (IEN).

In order for the ATMS to function as desired, the ATMS will require a physical support environment in terms of facilities, equipment, and personnel. At a minimum, the following facilities, equipment, and personnel resources will be required.

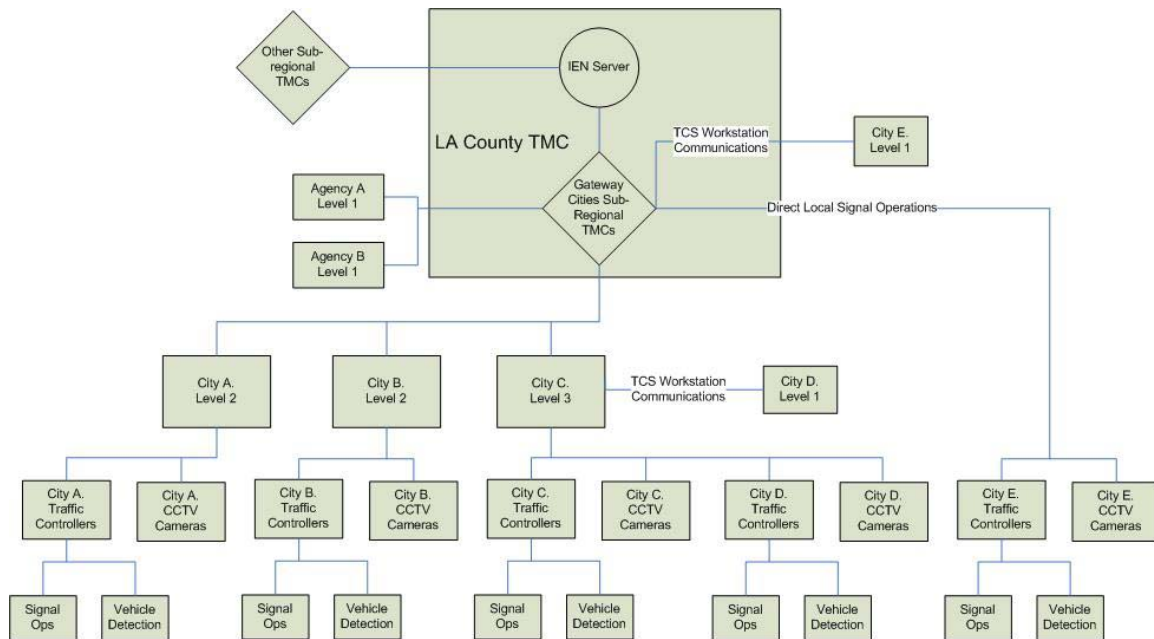
- Intersection traffic controllers that are able to support communications with a central ATMS system.
- ATMS server that supports communications with the intersection traffic signal controllers and the functions required for traffic signal monitoring and operations
- ATMS client workstations that allow local agency traffic operations and maintenance personnel to monitor traffic signal operations and to make changes in signal timing as needed.
- Vehicle detection to provide traffic count and speed data.
- In the future, CCTV cameras to monitor traffic conditions and to verify incidents as well as ATMS functionality to support CCTV camera operations and viewing of CCTV images.
- Communications to support the exchange of data between ATMS server(s) and client workstations as well as between ATMS server(s) and intersection traffic signal controllers.
- IEN server to support the exchange of traffic signal status and traffic congestion data between local agencies in the project area.
- IEN workstations to permit local agency traffic operations and maintenance personnel to view traffic signal status and traffic congestion data for neighboring jurisdictions.
- Local Control Centers or Traffic Management Centers to house the ATMS server and workstation(s) and IEN workstation(s).
- Traffic operations and maintenance staff to perform ATMS operations and maintenance work tasks.

4 OPERATIONAL SCENARIOS

The following are typical operating scenarios for local agencies participating at Level 1, Level 2, and Level 3 for this project. Each scenario is written to identify the typical operational process for each Level and is a description of how the ATMS would be used by local agency operations and maintenance personnel. Many of the scenarios are based on inter-agency agreements and may change as a result of the agreements.

The following figure is a breakdown of the elements for the project and their relationships.

Figure 4.1: Atlantic Boulevard/I-710 ATMS Project Relationships



4.1 Level 1 Operational Scenarios

At Level 1, local agency traffic operations and maintenance personnel will monitor their own traffic signal equipment, make changes in signal timing as needed using on-site ATMS workstation(s), and will be responsible for the maintenance of their traffic system including traffic signals, controllers, cameras and communications infrastructure. Local agency traffic operations and maintenance personnel will also be able to view traffic signal status and traffic congestion data for neighboring jurisdictions using IEN workstation(s).

Level 1 agencies may use the ATMS occasionally to monitor exceptional and unexpected congestion due to incidents or special events or may use the ATMS on a more regular basis to monitor traffic operations, depending on local agency requirements and the availability of resources for traffic operations and maintenance.

If an incident occurs within the city, the city will input data regarding the incident into the IEN workstation. The incident will be verified by using CCTV cameras if available, by viewing traffic speed data at an ATMS or IEN workstation, or by dispatching a field crew to visually inspect the nature of the incident. The city will be able to change timing plans, if warranted, in response to the incident or continue to monitor the situation through CCTV cameras or by viewing link traffic speeds and traffic congestion at an ATMS or

IEN workstation. Since the incident data has been posted by the city, it will be distributed through the IEN so that surrounding cities will also be able to monitor and, if necessary, change their timing plans. If the incident happens after normal working hours, it is possible that traffic operations personnel at the sub-regional or regional TMC could handle the incident according to pre-determined interagency agreements.

Each Level 1 local agency will control its own traffic signals and other field devices using one or more ATMS workstations. Working with the County or neighboring cities, Level 1 cities will be able to develop timing plans and strategies for arterial traffic and incident management. Cities will download signal timing changes or other updates using their ATMS workstation. The ATMS workstation will be connected to the ATMS server that is located in a Level 3 jurisdiction. When signal timing or a system malfunction arises operators will attempt to remotely reconfigure the signals; however, if the signals can not be fixed via the ATMS, a field crew will be dispatched. The field crew will be able to communicate with traffic operations staff at the ATMS workstation to correct the problem and verify if the traffic signal or other device is functioning correctly.

Additionally, traffic engineering staff will be able to generate daily status and other reports from the ATMS that will allow them to better respond to issues or citizen complaints.

IEN workstations those located at emergency service providers or at transit agencies will allow dispatchers to observe traffic signal status and incidents. Dispatchers will be able to alert emergency vehicles or buses of traffic signal outages or that an incident has occurred and will need further investigation. Often police field units are able to assist in traffic flow or even reset the controller when signals are not operating correctly. Traffic information on arterials as well as freeways will allow operators to respond to incidents by temporarily re-routing lines or inserting buses after incidents to maintain schedules for unaffected areas.

4.2 Level 2 Operational Scenario

The operational scenarios for traffic operations management including incident management using the ATMS for an agency at Level 2 will be the same as for Level 1 agencies, except that Level 2 agencies will be responsible for an ATMS server functions and for hosting the ATMS server equipment. It is also expected that Level 2 cities may have greater staff resources for ATMS operations and monitoring, compared to many Level 1 cities, so that Level 2 cities may monitor traffic conditions and traffic signal operations for more hours and utilize ATMS functions more frequently.

The ATMS servers hosted by the Level 2 cities will be installed at city-specified locations. Server maintenance functions will be the responsibility of the city.

4.3 Level 3 Operational Scenario

Level 3 agencies will host the ATMS server(s) for other cities in the project area. In addition to hosting the ATMS server(s), Level 3 agencies would have the ability to monitor traffic and incident data throughout the county using one or more IEN workstations and could contract with local agencies to monitor their ATMS system after normal working hours.

The operational scenarios for Level 3 agencies are generally the same as for Level 1 and 2 local agencies. Level 3 agencies will host the ATMS server(s) for Level 1 local agencies. It is especially important for a Level 3 jurisdiction to properly maintain and operate the ATMS server(s) as Level 1 agencies with only workstations rely on the

hosted server for communications with their traffic signals and other field devices. If an ATMS server fails in a Level 3 agency, the failure would be logged onto the IEN to notify neighboring jurisdictions that traffic signals were not being monitored.

4.4 Sub-Regional TMC Scenarios

The Sub-regional TMC will be located in the County TMC as recommended by the I-105 corridor project. Once the Sub-Regional TMC becomes operational, it is envisioned that the Sub-Regional TMC will coordinate the regional activities related to incident management and signal timing plan development requiring multi-jurisdictional operations.

4.4.1 Incident Management

Incidents involving multiple jurisdictions could be handled by traffic operations personnel at the Los Angeles County Sub-regional TMC. When an incident is identified, the Sub-regional TMC operator would become the manager of the incident. The operator will notify affected jurisdictions of the incident and request the activation of pre-approved timing plans. Individual city traffic engineering staff will decide if they will grant, hold pending verification, or deny the request based on their criteria and follow up investigations. When requests are made after normal city working hours, an on-call city traffic operations manager will be paged and notified. If there is no response from the city or from the on-call individual, the TMC operator would initiate the pre-approved timing plan after a pre-determined time frame. Once the incident is cleared, pre-existing timing plans would be re-established. This process for handling incidents involving multiple jurisdictions is illustrated in Figure 4.2.

4.4.2 Signal Coordination

For corridors traversing multiple-jurisdictions, the Sub-Regional TMC may coordinate the efforts of the involved agencies to develop timing plans to coordinate signals across jurisdictional boundaries. These timing plans will be scheduled using Information Exchange Network and will be implemented using local agency's traffic control systems. Each local jurisdictional will have full control over its signals.

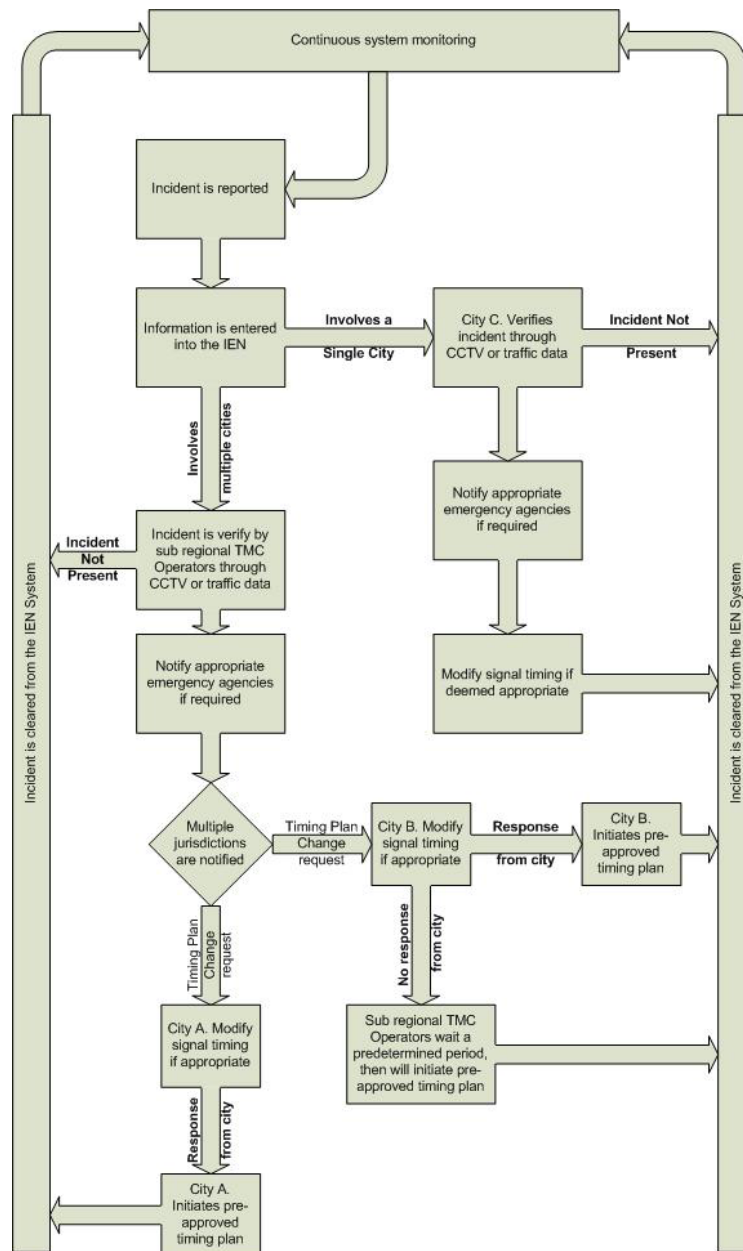


Figure 4.2: Multiple Agency Incident Management Scenario

Appendix A: Atlantic Blvd./I-710 Corridor Agency Interview